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For further information about Rocky Flats

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Also, additional information about Rocky Flats is available on the internet at: http://www.rfets.gov

ROCKY FLATS CLOSURE PROJECT

The Rocky Flats Industrial Area

Original Process Waste Lines

SUMMARY

Introduction

The Original Process Waste Lines (OPWL) were used to transport and store what is now classified as hazardous, mixed and radioactive liquid wastes at Rocky Flats from 1952 to the early 1980s. The OPWL consist of approximately 6 miles of process waste lines and 67 tanks, most of which have been abandoned. This summary presents a brief description of the OPWL, the waste streams they carried, the location and nature of the lines, the nature of the contaminant releases that were reported, and the proposed characterization and remediation approach.

It should be noted that although some of the data presented below is based on historical and engineering information, much of it, including pipeline depths, is based on professional judgments or approximations.

OPWL Waste Stream

The primary purpose of the system was to deliver liquid waste from buildings to a treatment system in Building 774. Most of the major buildings at Rocky Flats were connected to the system, including laboratories such as buildings 881 and 559; plutonium production facilities such as buildings 776, 777 and 779; and non-plutonium production facilities such as Buildings 441 and 460. Waste was stored in tanks at each building, then sent in bulk to a collection tank (Tank 207). Depending on the waste type, the waste was then routed to Building 774 or the Solar Evaporation Ponds for treatment, or it was sent east to Pond B-2 for storage. The liquid waste was then processed in a precipitation/filtration process in Building 774. Liquid wastes that were high in nitrate were sent directly to the Solar Evaporation Ponds.

The waste that the OPWL transported was liquid and generally aqueous (water based); however, some organic liquids entered the waste stream. The waste stream had both radioactive and hazardous constituents.

Radionuclides

The primary radionuclides entering the OPWL were plutonium, uranium and their decay products. Although there are some exceptions, for the most part, plutonium was used on the north side of the facility, primarily in the 700 Building Area, and uranium was used on the south side. Two factors helped keep the radionuclide levels in the waste stream low: economic recovery and the waste acceptance criteria for the Building 774 treatment system. Materials that had levels of plutonium above the Economic Discard Limit (the limit varied depending on the characteristics) were treated in Building 771 using dissolution and ion exchange. In this process, radionuclides as well as metals were removed from the waste stream. The treatment was repeated until levels of radionuclides fell below the Economic Discard Limit. Once depleted of recoverable materials, the remaining liquid was transferred to 774 for treatment through precipitation.

Waste acceptance criteria (WAC) for Building 774 also kept radionuclide levels low. The WAC set criteria for the liquid waste stream before it could enter the OPWL. Because the precipitation process in B774 concentrates radionuclides, the levels in the

entering waste stream had to be kept lower due to safety concerns and process limitations.

Non-Radionuclides

A variety of non-radioactive materials were also accepted in the OPWL, not all of which were hazardous. Depending on the building, these waste streams included:

- Acids
- Bases
- Chlorinated and non-chlorinated solvents
- Metals
- Petroleum-derived oils, grease, fuel oil and coolants
- Anions
- Trace amounts of polychlorinated biphenyls (PCBs)
- Soaps and detergents
- Antifreeze (ethylene glycol)
- Ammonium thiocyanate
- Photo developing chemicals
- Medical waste
- Pesticides and herbicides

B774 waste acceptance criteria were also applied to non-radioactive streams; however, there was no process for economic recovery of these materials.

OPWL Characteristics

The OPWL are mostly associated with the buildings that generated the hazardous and radioactive waste streams. These buildings generally have shorter lines and storage tanks that connect into larger transfer lines that move the waste stream to storage tanks at Building 774. Additional process waste lines connect to the Solar Ponds, Pond B-2 and interconnect storage tanks. The highest density of lines is beneath key process buildings and in the area south of Building 774. Manholes and valve vaults are at the junctions of most of the lines.

Most of the lines are generally above the water table and reside in the Rocky Flats Alluvium, a geologic unit that is the result of stream and debris-flow deposition. Table 1 gives an estimate of the depth of various lines relative the existing ground surface.

Table 1:
Estimated Length of OPWL at Various Depths

Depth	Length (feet)
Less than 3 feet	3,500
Three feet to 6 feet	20,500
Greater than 6 feet	13,600

The OPWL was constructed of a variety of materials. At some locations, the waste streams were caustic, therefore resistant materials such as Saran-lined steel pipe and Pyrex were used to prevent corrosion. Some lines were constructed of vitrified clay or other materials that had a higher potential to leak. An estimate of the materials of construction of the OPWL is presented in Table 2. Most of the lines are stainless steel, steel, or iron.

Table 2:
OPWL Materials of Construction

Materials of Construction	Length (feet)
Stainless steel	11,175
Black iron or cast iron	9,800
Vitrified clay	4,230
Steel and Saran-lined steel	7,220
Fiberglass	1,520
PVC (polyvinyl chloride)	2,495
Pyrex (borosilicate glass)	1,815
Cement-Asbestos	135

OPWL Releases

Most reported leaks occurred at locations where the piping was connected. Ruptures in the piping itself were rare. There are two basic types of releases that have been reported along the OPWL – small leaks that are difficult to detect and repair, and larger leaks that resulted in aqueous waste reaching the surface. These larger leaks were generally located and repaired immediately, and their locations tend to be better known. Sixty-nine locations have been identified as possible leak areas that are within 6 feet of the surface. Many of these are vague descriptions that often indicate that a leak could be anywhere along the line. Out of sixty-nine possible locations, 27 appear to have known locations that can be identified within a 10-foot radius and are within 6 feet of the ground surface. Nineteen of these locations are in the 700 Area; the rest are scattered across the Industrial Area (IA). There is greater confidence in reports of these leaks because they either occurred at visible locations such as valve vaults, or because a large enough volume was released to be visible at the surface. The remaining leaks are smaller and were not well documented.

When a release occurred, the nature and extent of the contamination remaining today is generally influenced by the size of the release, the type of contaminants and its relationship to groundwater (this is because the geologic setting is likely to be similar for all). Depending on the water chemistry, releases of hydrophilic contaminants (those that tend to stay in water) are more likely to be dispersed into the upper hydrologic unit and be spread out.

Uranium, in general, tends to be more hydrophilic and therefore is likely to reach the upper hydrologic unit and be dispersed over a larger area at a lower concentration. Plutonium is likely to remain closer to the leak point and be distributed in higher concentrations over a smaller area. Some contaminants like acids and bases are likely to be hydrophilic and are usually neutralized by the upper hydrologic unit once they go into solution. Other chemicals like detergents are likely to biodegrade readily. The more stable and concentrated contaminants are either those that tend to precipitate and/or form colloids or are free-phase solvents that tend to stay in a separate liquid phase. It appears that most of the waste streams were aqueous as opposed to a separate organic phase.

Characterization Approach

Characterization of the OPWL will be conducted on pipelines that are below 3 feet of the ground surface. Lines that are closer than 3 feet to the surface will not be characterized since these lines will be removed. Characterization of the OPWL will have three components:

Sampling of known leaks – Biased sampling will be performed on the 19 known leaks in the 700 Area plus an additional eight known leaks across the site.

Sampling in area of suspected release locations – Biased sampling of 700 Area lines will be performed in areas where the lines are prone to leaks such as valve elbows, tees, penetrations into buildings, etc., and areas that were historically suspected of leaking. In addition, samples will be taken every 50 to 200 feet of line depending on pipeline composition.

Overlap with other sampling areas – Additional sampling in the Industrial Area for IHSS, under-building contamination (UBC), Potential Area of Concern (PAC), and white space (uncontaminated areas) will overlap OPWL.

All sampling will be conducted in accordance with the Industrial Area Sampling and Analysis Plan (SAP). If contaminants are detected above the applicable action level, then additional sampling will be performed as described by the SAP.

Remedial Approach

All lines above 3 feet and all manholes and valve vaults will be removed to the extent practical. Areas of the pipeline below 3 feet will be remediated to acceptable residual risk based on the characterization results. Flushing will not be performed since it might mobilize contaminants. Instead, grouting or foaming will be done to the extent practical through valve vault removal or other means.

Underground lines seen through a manhole.

Summary

Several key points need to be considered in evaluating the OPWL:

- Low levels of plutonium were generally discharged through the OPWL on the north side of Rocky Flats and were mostly confined to the 700 area. Uranium is generally confined to the south side of the facility and the Solar Ponds.
- Great effort was made to recover radionuclides and metals through numerous processes in Building 771 and Building 774.
- The Building 774 WAC limited the levels of contaminants in the waste stream.
- Uranium is more likely to be dispersed into the shallow groundwater, and plutonium is more likely to remain close to its point of origin.
- The densest area of OPWL is in the 700 area, particularly the area south of Building 774.
- OPWL are constructed of a variety of materials, with the most common materials being stainless steel, steel and cast iron.
- Most of the reported leaks occurred at locations where the pipes are joined.
- Twenty-seven reported leaks occurred at readily identified locations, 18 of these are in the 700 Area.